AMENDMENTS TO THE CLAIMS

Claims 1-36 (canceled)

37. (original) A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a diffusion barrier layer on a base layer;

forming a nitrided metal layer on the diffusion barrier layer, wherein the nitrided metal layer comprises a first metal component, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen, wherein the second metal component has a surface energy lower than a surface energy of the first metal component, and wherein the nitrided metal layer is rich in the first metal component;

forming a second metal layer on the nitrided metal layer, wherein the second metal layer comprises the first metal component; and

removing excess portions of the second metal layer to define the metal interconnect.

38. (original) The method of claim 37, wherein forming a nitrided metal layer further comprises performing a physical vapor deposition process in a nitrogen-containing atmosphere using a physical vapor deposition source containing the first and second metal components.

39. (original) The method of claim 38, wherein the physical vapor deposition source is a composite source having a first portion containing the first metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components.

40. (original) The method of claim 39, wherein the first and second portions of the physical vapor deposition source are intermixed.

41. (original) The method of claim 37, wherein forming a nitrided metal layer further comprises sputtering a composite target in a nitrogen-containing atmosphere, wherein the composite target has a first portion containing the first

metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components, and wherein the nitrogen-containing atmosphere comprises approximately 5% to 30% by volume of nitrogen in an inert gas.

42. (currently amended) ~~The method of claim 41,~~ A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a diffusion barrier layer on a base layer;

forming a nitrided metal layer on the diffusion barrier layer, wherein the nitrided metal layer comprises a first metal component, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen, wherein the second metal component has a surface energy lower than a surface energy of the first metal component, and wherein the nitrided metal layer is rich in the first metal component;

forming a second metal layer on the nitrided metal layer, wherein the second metal layer comprises the first metal component; and

removing excess portions of the second metal layer to define the metal interconnect;

wherein forming a nitrided metal layer further comprises sputtering a composite target in a nitrogen-containing atmosphere, wherein the composite target has a first portion containing the first metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components, and wherein the nitrogen-containing atmosphere comprises approximately 5% to 30% by volume of nitrogen in an inert gas; and

wherein the first and second portions of the composite target are intermixed.

43. (original) The method of claim 41, wherein the inert gas is argon.

44. (original) The method of claim 37, wherein the diffusion barrier layer is a titanium-containing layer.

45. (original) The method of claim 37, wherein the diffusion barrier layer is titanium nitride.

46. (original) The method of claim 37, wherein the first metal component is selected from the group consisting of copper, silver, gold, palladium, platinum, rhenium, iridium, ruthenium and osmium.

47. (original) The method of claim 37, wherein the second metal component is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium.

48. (original) The method of claim 37, wherein forming a second metal layer on the nitrided metal layer further comprises forming a seed layer on the nitrided metal layer and forming a metal layer on the seed layer, and wherein the seed layer and the metal layer each contain the first metal component.

49. (original) The method of claim 48, wherein the seed layer consists essentially of the first metal component.

50. (original) The method of claim 37, wherein the base layer is selected from the group consisting of a semiconductor substrate and a conductor layer.

51. (withdrawn) A method of forming a metal interconnect in an integrated circuit device, the method comprising:
forming a dielectric layer on a base layer;
forming a recess in the dielectric layer;
forming a diffusion barrier layer on sidewalls of the recess and a surface of the base layer;
forming a nitrided metal layer on the diffusion barrier layer, wherein the nitrided metal layer comprises a first metal component, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen, wherein the second metal component has a surface energy

lower than a surface energy of the first metal component, and wherein the nitrided metal layer is rich in the first metal component;

forming a metal layer on the nitrided metal layer, wherein the metal layer comprises the first metal component and wherein the metal layer fills the recess and overlies a surface of the dielectric layer; and

removing portions of the diffusion barrier layer, the nitrided metal layer and the metal layer overlying the surface of the dielectric layer to define the metal interconnect as portions of the diffusion barrier layer, the nitrided metal layer and the metal layer remaining in the recess.

52. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer comprises a nitride metal alloy compound containing a first metal component, a second metal component and nitrogen, wherein the second metal component is selected from the group consisting of Group IIIA and Group IVA elements, and wherein an atomic ratio of the first metal component to the second metal component in the nitrided metal layer is greater than one; and

forming a metal layer on the nitrided metal layer, wherein the metal layer comprises the first metal component.

53. (withdrawn) The method of claim 52, wherein the atomic ratio of the first metal component to the second metal component in the first metal layer is greater than two.

54. (withdrawn) The method of claim 52, wherein the atomic ratio of the first metal component to the second metal component in the first metal layer is greater than ten.

55. (withdrawn) The method of claim 52, wherein the atomic ratio of the first metal component to the second metal component in the first metal layer is greater than twenty.

56. (withdrawn) A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a dielectric layer on a base layer;

forming a recess in the dielectric layer;

forming a titanium nitride layer on sidewalls of the recess and a surface of the base layer;

forming a nitrided metal layer on the titanium nitride layer, wherein the nitrided metal layer comprises copper, a metal component capable of forming a crystalline compound with the copper, and nitrogen, wherein the metal component is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium, and wherein an atomic ratio of copper to the metal component in the nitrided metal layer is greater than one;

forming a copper layer on the nitrided metal layer, wherein the copper layer fills the recess and overlies a surface of the dielectric layer; and

removing portions of the titanium nitride layer, the nitrided metal layer and the copper layer overlying the surface of the dielectric layer to define the metal interconnect as portions of the titanium nitride layer, the nitrided metal layer and the copper layer remaining in the recess.

57. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer is of the form MT_xN_y, where M is a first metal component, T is a Group IIIA or Group IVA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N, and x and y are each less than one; and

forming a metal layer on the nitrided metal layer, wherein the metal layer comprises the first metal component.

58. (withdrawn) The method of claim 57, wherein forming a layer of titanium nitride further comprises forming a layer of titanium nitride covering sidewalls and a bottom of a recess.

59. (withdrawn) The method of claim 58, wherein a portion of the layer of titanium nitride covering the bottom of the recess is in contact with a base layer underlying a dielectric layer.

60. (withdrawn) The method of claim 59, wherein the base layer is selected from the group consisting of a semiconductor substrate and a conductor layer.

61. (withdrawn) The method of claim 57, wherein M is selected from the group consisting of copper, silver, gold, palladium, platinum, rhenium, iridium, ruthenium and osmium.

62. (withdrawn) The method of claim 57, wherein T is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium.

63. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer is of the form MT_xN_y, where M is a first metal component, T is a Group IIIA or Group IVA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N, x is less than approximately 0.1 and y is less than approximately 0.9; and

forming a metal layer on the nitrided metal layer, wherein the metal layer comprises the first metal component.

64. (withdrawn) The method of claim 63, wherein x is less than approximately 0.05.

65. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer is of the form CuT_xN_y, where Cu is copper, T is a Group IIIA or Group IVA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N, and x and y are each less than one; and

forming a metal layer on the nitrided metal layer, wherein the metal layer comprises copper.

66. (withdrawn) The method of claim 65, wherein T is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium.

67. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer is of the form CuT_xN_y, where Cu is copper, T is a Group IIIA or Group IVA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N, x is less than approximately 0.1 and y is less than approximately 0.9; and

forming a copper layer on the nitrided metal layer.

68. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer comprises copper, a metal component selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium

and hafnium, and nitrogen, wherein an atomic ratio of copper to the metal component in the nitrided metal layer is greater than ten; and

forming a copper layer on the nitrided metal layer.

69. (withdrawn) The method of claim 68, wherein the atomic ratio of copper to the metal component in the nitrided metal layer is greater than twenty.

70. (withdrawn) A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a dielectric layer on a base layer;

forming a recess in the dielectric layer;

forming a titanium nitride layer on sidewalls of the recess and a surface of the base layer;

forming a nitrided metal layer on the titanium nitride layer, wherein the nitrided metal layer comprises silver, a metal component capable of forming a crystalline compound with the silver, and nitrogen, wherein the metal component is selected from the group consisting of scandium, yttrium and lanthanum, and wherein an atomic ratio of silver to the metal component in the nitrided metal layer is greater than one;

forming a silver layer on the nitrided metal layer, wherein the silver layer fills the recess and overlies a surface of the dielectric layer; and

removing portions of the titanium nitride layer, the nitrided metal layer and the silver layer overlying the surface of the dielectric layer to define the metal interconnect as portions of the titanium nitride layer, the nitrided metal layer and the silver layer remaining in the recess.

71. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer is of the form AgT_xN_y, where Ag is silver, T is a

Group IIIA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N, and x and y are each less than one; and

forming a metal layer on the nitrided metal layer, wherein the metal layer comprises silver.

72. (withdrawn) The method of claim 71, wherein T is selected from the group consisting of scandium, yttrium and lanthanum.

73. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer is of the form AgT_xN_y, where is silver, T is a Group IIIA transition metal, N is nitrogen, x is an atomic fraction of T, y is an atomic fraction of N, x is less than approximately 0.1 and y is less than approximately 0.9; and

forming a silver layer on the nitrided metal layer.

74. (withdrawn) The method of claim 73, wherein x is less than approximately 0.05.

75. (withdrawn) A method of forming a portion of an integrated circuit device, the method comprising:

forming a layer of titanium nitride;

forming a nitrided metal layer on the layer of titanium nitride, wherein the nitrided metal layer comprises silver, a metal component selected from the group consisting of scandium, yttrium and lanthanum, and nitrogen, wherein an atomic ratio of silver to the metal component in the nitrided metal layer is greater than ten; and

forming a silver layer on the nitrided metal layer.

76. (withdrawn) The method of claim 75, wherein the atomic ratio of silver to the metal component in the nitrided metal layer is greater than twenty.

77. (withdrawn) A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a dielectric layer on a base layer;

forming a recess in the dielectric layer;

forming a titanium nitride layer on sidewalls of the recess and a surface of the base layer;

forming a nitrided metal layer on the titanium nitride layer using a physical vapor deposition process in a nitrogen-containing atmosphere and a physical vapor deposition source containing copper and a metal component capable of forming a crystalline compound with copper, wherein the metal component is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium, and wherein an atomic ratio of copper to the metal component in the nitrided metal layer is greater than one;

forming a copper layer on the nitrided metal layer, wherein the copper layer fills the recess and overlies a surface of the dielectric layer; and

removing portions of the titanium nitride layer, the nitrided metal layer and the copper layer overlying the surface of the dielectric layer to define the metal interconnect as portions of the titanium nitride layer, the nitrided metal layer and the copper layer remaining in the recess.

78. (withdrawn) The method of claim 77, wherein the physical vapor deposition source is a composite source having a first portion containing copper in an elemental state and a second portion containing the crystalline compound of copper and the metal component.

79. (withdrawn) The method of claim 78, wherein the crystalline compound is copper-rich.

80. (withdrawn) The method of claim 78, wherein the first and second portions of the physical vapor deposition source are intermixed.

81. (withdrawn) The method of claim 77, wherein the physical vapor deposition process is a sputtering process.

82. (withdrawn) The method of claim 77, wherein the nitrogen-containing atmosphere comprises approximately 5% to 30% by volume of nitrogen in an inert gas.

83. (withdrawn) The method of claim 80, wherein the inert gas is argon.

84. (withdrawn) A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a dielectric layer on a base layer;

forming a recess in the dielectric layer;

forming a titanium nitride layer on sidewalls of the recess and a surface of the base layer;

forming a nitrided metal layer on the titanium nitride layer using a physical vapor deposition process in a nitrogen-containing atmosphere and a physical vapor deposition source containing silver and a metal component capable of forming a crystalline compound with silver, wherein the metal component is selected from the group consisting of scandium, yttrium and lanthanum, and wherein an atomic ratio of silver to the metal component in the nitrided metal layer is greater than one;

forming a silver layer on the nitrided metal layer, wherein the silver layer fills the recess and overlies a surface of the dielectric layer; and

removing portions of the titanium nitride layer, the nitrided metal layer and the silver layer overlying the surface of the dielectric layer to define the metal interconnect as portions of the titanium nitride layer, the nitrided metal layer and the silver layer remaining in the recess.

85. (withdrawn) The method of claim 84, wherein the physical vapor deposition source is a composite source having a first portion containing silver in an

elemental state and a second portion containing the crystalline compound of silver and the metal component.

86. (withdrawn) The method of claim 85, wherein the crystalline compound is silver-rich.

87. (withdrawn) The method of claim 85, wherein the first and second portions of the physical vapor deposition source are intermixed.

88. (withdrawn) The method of claim 84, wherein the physical vapor deposition process is a sputtering process.

89. (withdrawn) The method of claim 84, wherein the nitrogen-containing atmosphere comprises approximately 5% to 30% by volume of nitrogen in an inert gas.

90. (withdrawn) The method of claim 87, wherein the inert gas is argon.

91-144. (canceled)

145. (withdrawn) A method of forming a metal interconnect in an integrated circuit device, the method comprising:

forming a titanium nitride layer on a base layer;

forming a nitrided metal layer on the titanium nitride layer, wherein the nitrided metal layer comprises a first metal component, a second metal component capable of forming a crystalline compound with the first metal component, and nitrogen, wherein the second metal component has a surface energy lower than a surface energy of the first metal component, and wherein the nitrided metal layer is rich in the first metal component;

forming a second metal layer on the nitrided metal layer, wherein the second metal layer comprises the first metal component; and

removing excess portions of the second metal layer to define the metal interconnect;

wherein the first metal component is selected from the group consisting of copper, silver, gold, palladium, platinum, rhenium, iridium, ruthenium and osmium; and

wherein the second metal component is selected from the group consisting of scandium, yttrium, lanthanum, titanium, zirconium and hafnium.

146. (withdrawn) The method of claim 145, wherein forming a nitrided metal layer further comprises performing a physical vapor deposition process in a nitrogen-containing atmosphere using a physical vapor deposition source containing the first and second metal components.

147. (withdrawn) The method of claim 146, wherein the physical vapor deposition source is a composite source having a first portion containing the first metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components.

148. (withdrawn) The method of claim 147, wherein the first and second portions of the physical vapor deposition source are intermixed.

149. (withdrawn) The method of claim 145, wherein forming a nitrided metal layer further comprises sputtering a composite target in a nitrogen-containing atmosphere, wherein the composite target has a first portion containing the first metal component in an elemental state and a second portion containing the crystalline compound of the first and second metal components, and wherein the nitrogen-containing atmosphere comprises approximately 5% to 30% by volume of nitrogen in an inert gas.

150. (withdrawn) The method of claim 149, wherein the first and second portions of the composite target are intermixed.

151. (withdrawn) The method of claim 149, wherein the inert gas is argon.

152. (withdrawn) The method of claim 145, wherein forming a second metal layer on the nitrided metal layer further comprises forming a seed layer on the nitrided metal layer and forming a metal layer on the seed layer, and wherein the seed layer and the metal layer each contain the first metal component.

153. (withdrawn) The method of claim 152, wherein the seed layer consists essentially of the first metal component.

154. (withdrawn) The method of claim 145, wherein the base layer is selected from the group consisting of a semiconductor substrate and a conductor layer.